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## YARD WASTE COMPOSTING

# Diverting Debris from The Landfill

California refuse collection firm "claws and grinds" its way to a successful composting program.

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THE SEED of the composting program in Davis, California was planted in 1972 with the development of the Claw, a pincher bucket attachment for a loader, designed for the purpose of efficiently collecting plant wastes from residential areas. Residents are asked to keep their yard wastes separate from their other household wastes and place them in the street for separate collection. A two-person crew, one in the loader and the other in a rear-loading packer truck, are able to collect over 400 tons of clean yard and garden prunings per month.

Since 400 tons per month is more than two refuse collectors would normally be expected to pick up, this system may be added without additional manpower, if it is accompanied by a reassignment of collection routes. The result of this improved efficiency in refuse collection was truck after truck load of nothing but clean plant material being taken to the landfill to be mixed and buried with the other wastes of the city.

In Davis, there is a strong seasonal variation in the amount of material collected, and three basic variations in the type of material available. During the fall season, over 600 tons per month of mostly leaves are collected. Following the leaf fall, there is heavy pruning of deciduous fruit trees. This material is very woody and amounts to about 250 tons per month. There is a burst of pruning at the beginning of spring (normally early March) and then a relatively quiet four to six weeks while everything is in flower but the grass has not really started growing rapidly. During the warm months, an av-



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erage of 360 tons per month is collected. Finally, as fall approaches again and growth slows, there is another calm period before the leaves come down again.

In 1981, the Davis Waste Removal Company (DWR) initiated a composting program to process much of the plant wastes that had been hauled to the landfill. Processing includes the removal of contaminants from the collected material, grinding the vegetation to an even consistency, windrowing and composting the materials, and marketing of the final product.

With partial funding from the California Waste Management board, DWR purchased a loader similar to the one used for brush collection, and a "beefed up" W.H.O. Forage Grinder, designed initially to grind plants and seeds into animal feed. The grinder is in the shape of a large tub which rotates to bring the plant wastes to the hammermill. The hammers cut the brush until it is in pieces small enough to drop through screens, and onto a dis-

charge conveyor. Screens with openings from one-half inch all the way up to five inches can be used to change the coarseness of the ground material. The ground material is discharged into a debris box for transport to the composting site.

The grinder is capable of grinding woody material up to 12 inches in diameter, but we try not to run anything larger than 4 inches across. Most material is ground through the two inch screens as a compromise. Less energy is used in grinding through larger screens and the hammers last longer, but the particle size is still too large for the material to decompose in less than two years.

When finer screens are used, the hammer wear is excessive and the high moisture level of the material (average of about 60% for fresh brush) tends to pack the material on the screens further slowing down the grinding and producing a finer than intended material. The main emphasis of the grinding is to reduce the size of the particles to create more surface

area for the microorganisms to attack, and to even size the particles so that the pile breaks down at about the same rate.

In Davis, brush is collected four days a week (in 10 hour days), Monday through Thursday. Any debris left behind by the brush crew is cleaned up the following day by our street sweepers. An average of 10 truck loads per week are collected. The 30 cubic yard packer body will hold over 10 tons of compacted brush, but is frequently not filled to capacity at the end of the day.

When the truck packs out, it returns to our corporation yard and unloads onto a concrete pad next to the grinder. Additionally we have constructed a four foot high ramp in front of the grinder so that the loader will not have to lift as high to dump brush into the tub. The loading height of the tub is 10 feet 6 inches. Our grinder loader is equipped with a quick-disconnect so that we may change the loading attachment as needed. In addition to the Claw, we use a brush rake and a bucket.

The hammermill in the grinder turns at 2400 RPM, with a diameter including hammers of 25 inches. There are places for up to 96 hammers on the mill but we run with only 48, 12 hammers on four of the eight hammer rods. The grinder uses about 12 gallons of diesel fuel per hour of operation. A set of hammers will last from 8 hours to 50 hours depending on the size of the screens, the moisture content of the brush, and the type of material being ground.

The ground vegetation is conveyed directly into a box and hauled to the compost site. At the compost site, the plant material is dumped out and formed into windrows. Because of the low nitrogen content of the material, we use large piles, about 12 feet wide at the base and 6-8 feet high. During the hot, dry summer months, the top of the piles are formed concave and about four feet across so that water that is applied soaks into the pile. During the wet winter months, the piles are peaked and packed down so that the rain water drains off and away from the pile without penetration so that no leachate is produced.

The dimensions of the windrow are determined in part by the needs of the microorganisms that decompose the plant material into humus. The controlling factors include the amount of air in the pile, the moisture content of the brush and the temperatures generated by the microbial activity.

For aerobic decomposition to occur (as compared to the more odiferous anaerobic decomposition), the organisms at the

center of the pile must be able to get fresh air. If the material is ground coarsely, air will be able to penetrate the pile at all times. However, it then takes longer for the material to reach a humus-like condition. When the material is ground to a finer size, it packs down tighter and the pile must be turned or fluffed to continue the oxygen supply to the center of the pile.

Moisture is essential to the organisms that decompose the plant wastes into compost. A moisture level of about 50% should be maintained, but there is considerable leeway. The upper limit is saturation; beyond which water leaks out of the pile and leachate is produced. The lower limit is reached when the microorganisms stop their activities. At this point, the process of decomposition slows drastically. If space is not a problem, no negative environmental effects arise from too low a moisture level.

With proper moisture and oxygen levels, the activity of the microorganisms will heat up the pile. Temperatures of

#### **Yard debris comprises almost one-third of the residential wastes in Davis, California.**

140°F. are reached within 48 hours and are maintained for periods in excess of 3 days. This is sufficient to destroy most pathogens and weed seeds, and ensure "sterility" of the material.

Although the material continues to decompose until it is totally broken down, within three to four months of composting activity, the piles are reasonably well stabilized and the material can be used. However, we allow most of the material to continue to decompose for at least one year before sale, and some of the coarse grindings longer than that. Our top quality material is reground through the one inch screens, after it has composted, to produce an even textured fine size.

Our current storage site is only three acres, which is not sufficient to store a full years production of ground vegetation. In order to make room for new material, some of the mulch must be sold or given away before it has completely composted. Some of the coarse material is sold for weed abatement/ground cover. Some is spread out and allowed to dry and then sold for boiler fuel. Until we can acquire a larger site, when the existing site fills up, excess brush is taken to the landfill.

Our primary markets for "composted urban wood wastes" are the local landscapers and nurseries. The forestry wastes that have been the feedstocks for their potting mixes are now in part being used to fire boilers, and our compost can be a substitute for them. However, because our brush collection has no control over seasonal variation in the material composted, and we cannot afford to test each batch, the larger users continue to utilize forest bark waste. Some of the most inexpensive compost marketed is basically sawdust, and has very little nutritive value for plants, but sells at a low price. About 25% of the compost produced has been given free to the residents of the city for use in their gardens and yards.

Further, we must compete with the cost of landfilling. In Yolo County, the tipping fee for refuse is \$4.00 per ton. With a net production cost of almost \$25.00 per ton, we must sell our compost for over \$20.00 per ton just to break even as compared to landfilling the brush. And for every ton that we return to the residents of Davis for their own use, the cost of the remaining material must be that much higher to offset our costs.

An average of the analyses of our composted brush yields:

|                 |                           |
|-----------------|---------------------------|
| Moisture        | 60%                       |
| Total Solids    | 40%                       |
| Volatile Solids | 34%                       |
| C/N ratio       | 45:1                      |
| Carbon          | 22%                       |
| Nitrogen        | .48% = 9.6 pounds per ton |
| Phosphorous     | .16% = 3.2 pounds per ton |
| Potassium       | .24% = 4.8 pounds per ton |

While this analysis shows that our compost is not a fertilizer, it does point out that this material is a better than average soil amendment, which is particularly useful in the heat of our dry California central valley summers in reducing the need for irrigation.

The tree and shrub prunings and other yard debris comprise 18% of the total waste of the city of Davis (almost one-third of the residential wastes). Because of the convenience of the collection system, virtually all of the yard wastes are collected by DWR. In addition to removing almost one-fifth of all the wastes from the landfill and producing a reusable product, our compost program has the advantage over our other recycling programs in that the resident is given something—quality compost. The community support for this program has been very high and has encouraged residents to take a closer look at all of the wastes that they generate. □